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PROGRESS IN SOIL AND WATER CONSERVATION RESEARCH

*a
quarterly
report*

Soil and Water Conservation Research Division
Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE
No. 18



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Assembled in the Office of the Director by R. S. Dyal, Special Assistant to the Director.

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IRRIGATION

Nebraska

ESTABLISHING ALFALFA IN IRRIGATION BASINS IS SUCCESSFUL

O. W. Howe, Mitchell. --One of the advantages for the basin irrigation system recently constructed on the Tripp very fine sandy loam soil of the Scotts Bluff Field Station is the ease with which excellent alfalfa stands have been established on the level basins. Corn has displaced barley as a companion crop for alfalfa seedlings on the basins, because it is the more profitable of the two crops. Many attempts to start alfalfa with corn under down-the-slope irrigation have failed due to drying out of the seedlings on the ridges. Under basin irrigation, it is not necessary to make ridges. The basins are flood irrigated so all seedlings obtain adequate moisture.

At first, the alfalfa was drilled in between the corn rows with a modified alfalfa drill following the last cultivation. This year, two different areas were seeded with complete success merely by broadcasting the seed with a whirlwind seeder immediately following the last cultivation, after which the regular irrigation for the corn germinated the alfalfa seed. Stands were most even where the soil was the most cloddy affording many crevices in which the seed could lodge thus preventing it from being floated out of place.

A test is being conducted at the Scotts Bluff Field Station this year to determine what row spacing and plant density combination will result in highest yields of corn and yet provide a satisfactory environment for establishing an alfalfa stand.

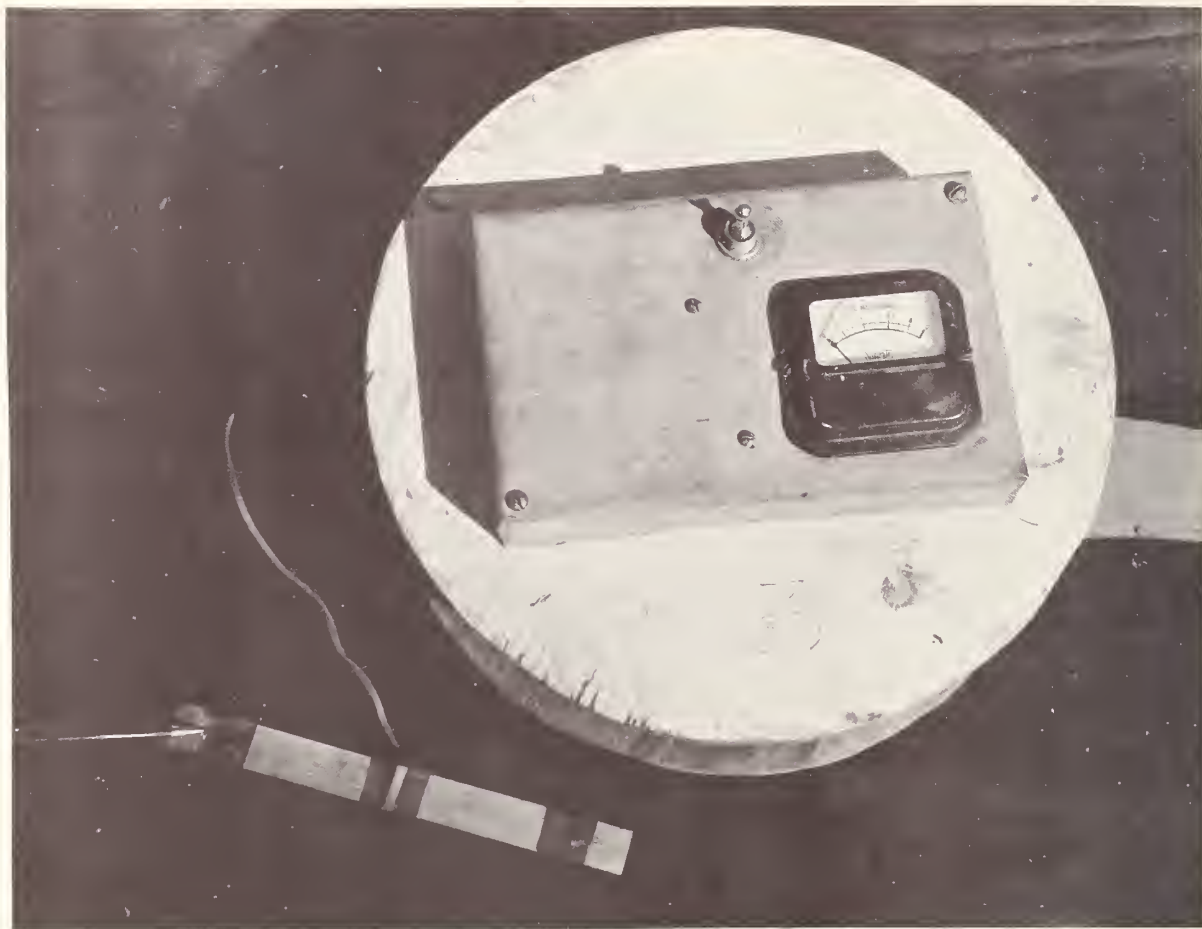
Nebraska

FURROW STREAM VELOCITIES DETERMINED BY SALT INJECTION

Norris P. Swanson, Lincoln. --Furrow stream velocity measurements can be made with injections of ammonium sulfate, a simple electronic circuit, and a stopwatch. Field use of this equipment in 1958 has been limited to measurement of the velocity of runoff in furrows from simulated rainfall, but it should work equally well with irrigation furrow streams. Velocities as low as 0.11 f. p. s. were measured over a 100-foot length of furrow. Extremely low velocities may prohibit the use of this technique, but high velocities can be readily measured.

A concentrated ammonium sulfate solution is injected by means of a 1-quart capacity dipper at a selected upstream station. The furrow stream velocity is determined by stopwatch timing of the period required for the more highly ionized solution to reach pairs of electrodes at successive downstream stations in the furrow. The electrodes employed are exposed tips (about 1/16" long) of small copper wire with rubber or plastic insulation. The electrodes are connected to a small piece of wood (7" x 3/4" x 3/8") which spaces them 6 inches apart and also serves as a float in the furrow stream. An inexpensive 0-10 milliammeter connected in series with a midget 45-volt battery, a 1500 ohm 1-watt resistor, a toggle switch, and the electrodes, comprise the circuit. This circuit is often employed in well drawdown meters.

The pencil in the accompanying photograph points to an electrode on the wood float. This equipment was laboratory constructed with the meter mounted on a wooden reel large enough to accommodate 400 or 500 feet of double-conductor wire. Operation in the field is simplified by placing all of the meters together at a convenient location, usually close to the point of injection, if only one man is available to operate the equipment. Light weight speaker wire was found to be very satisfactory for connecting the electrodes to the meter.



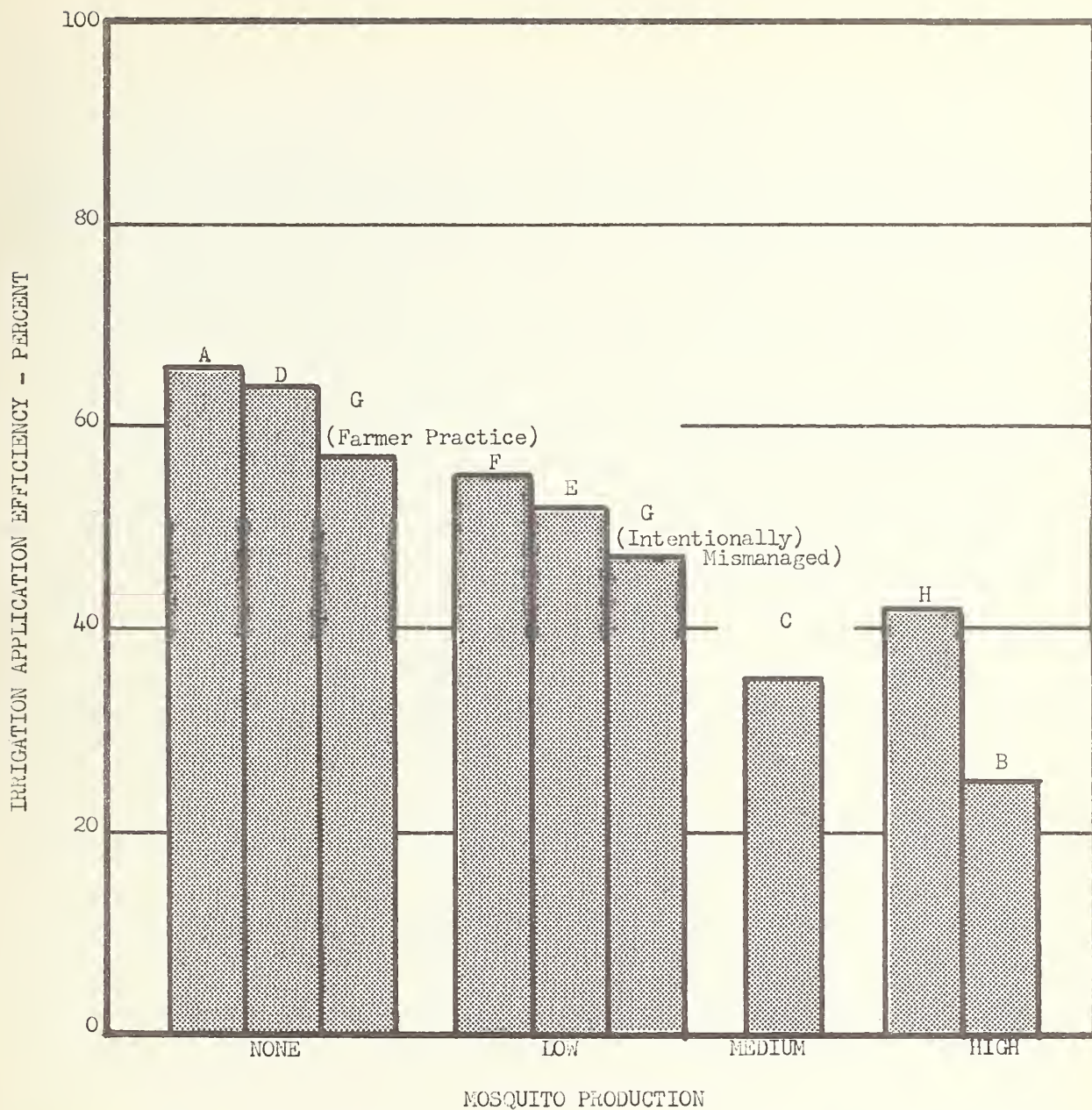
Milliammeter and associated electronic equipment used for furrow stream velocity measurements with salt injection. The pencil points to one of the small electrodes on the wooden float.

California

ABUNDANCE OF MOSQUITOES RELATED TO IRRIGATION EFFICIENCY

R. C. Husbands, Dean C. Muckel, and N. A. MacGillivray, Lompoc. --An inverse relationship between irrigation application efficiency and mosquito production in irrigated pastures has been demonstrated in a 3-year study conducted in cooperation with the California State Department of Public Health at Merced, Calif. This relationship is graphically illustrated in the accompanying figure. The pastures studied were on fine-textured soils, and all were border-strip irrigated, with the exception of pasture "C", (see figure) which had contour borders.

A means of reducing mosquito populations through more discriminate irrigation practices is immediately apparent.



Seasonal irrigation efficiency and mosquito production in several irrigated pastures, Merced County, Calif., 1954 to 1956

DRAINAGE

California

Mg-Ca RATIO ASSOCIATED WITH SOILS OF MARINE ORIGIN

V. S. Aronovici and Luther P. Grass, Pomona. --The importance of magnesium-calcium ratio as an index of reclamation and soil origin is apparent from a study of submerged reclaimed sediments in the San Francisco Bay area. As submerged marine sediments emerge from the direct influence of sea water and are reclaimed, the magnesium-calcium ratio is lowered.

With the exception of special geological regions, most soils contain more calcium than magnesium. Sea water contains about five times more magnesium than calcium. In soils formed under conditions where it is known that soils of the region are not high magnesium soils, this ratio will reflect marine influences.

The accompanying table summarizes a group of analyses taken in areas of known marine influence. The Tracy soil of the Upper San Joaquin Delta area is slightly influenced, but the San Jacinto Basin soil is definitely not associated with marine sedimentation. Note that the soil reclaimed for 65 years still reflects the marine influence.

Used with caution, this ratio may be an excellent index of reclamation and soil origin. For example, these data suggest that sediments now unreclaimed are similar in character to the reclaimed soils. Consequently, their performance will suggest the way in which the marine sediments will act when reclaimed.

The magnesium-calcium ratio of a selected group of sediments showing pH and total soluble cations

Location description	Analysis ¹	Depth of sampling (in feet)					Average pH
		0-1	1-2	2-3	3-4	4-5	
Sea water, South San Francisco Bay	ratio	5.2	--	--	--	--	--
	TSC	491	--	--	--	--	7.1
Sediments from bottom of San Pablo Bay	ratio	5.2	--	--	--	--	--
	TSC	247	--	--	--	--	7.1
Sediments emerged 1 year from Bay	ratio	5.8	--	--	--	--	--
	TSC	214	--	--	--	--	7.1
Bay sediments reclaimed 2 years	ratio	5.8	6.1	5.6	7.0	3.9	
	TSC	304	613	480	414	418	7.0
Bay sediments reclaimed 8 years	ratio	4.0	3.6	2.3	--	--	
	TSC	155	232	247	--	--	9.5
Bay sediments reclaimed 65 years	ratio	2.5	2.2	3.2	3.5	4.1	
	TSC	18	19	47	91	129	3.8
Tracy, Calif., (Upper San Joaquin Delta area)	ratio	0.7	0.8	1.8	1.1	1.0	
	TSC	96	91	69	57	49	6.5
San Jacinto Basin, California (Continental)	ratio	0.5	0.2	0.5	0.4	0.4	
	TSC	235	139	305	241	186	8.0

¹ Ratio: Magnesium in meq/l divided by calcium in meq/l.

TSC: Total soluble cations.

EROSION AND RUNOFF CONTROL

Texas

CUTTING HEIGHT OF ROW SORGHUM IMPORTANT IN ERODIBILITY

Earl Burnett, N. H. Welch, and G. L. Randel, Big Spring. --Forage sorghums are normally cut as close to the ground level as possible in order to obtain the maximum amount of plant material for feed purposes. This practice leaves very little residue on the soil surface for wind erosion control. In 1957, forage sorghum was planted in 40- and 20-inch rows and cut for silage at 2 heights, 4 and 12 inches, to determine the effect on yields and relative erodibility.

Average green weight yields are presented in the accompanying table.

Effect of row width and cutting height on yield of forage sorghum, Big Spring, Tex.

Cutting Heights	Average yield, green weight, per acre	
	40-Inch rows	20-Inch Rows
	<i>Pounds</i>	<i>Pounds</i>
4 inches.....	6,229	10,718
12 inches.....	5,019	8,951

Using a cost figure of \$8 per ton for silage, the 20-inch row width would return \$16.96 more per acre than the 40-inch row width. Cutting at the usual height of 4 inches brought a gross of \$5.95 more per acre than cutting at the 12-inch height. The 20-inch rows cut at the 12-inch height returned \$9.10 more than the 40-inch rows cut at the 4-inch height.

The 20-inch rows contained almost twice as many plants per acre as did the 40-inch rows. This may account for a large portion of the difference in yield between the two row widths.

A very marked difference in the amount of wind erosion occurred on these plots during the windy season of 1958. Very little soil shifting occurred on the area which had been in 20-inch rows and cut at a 12-inch height. Progressively, more shifting took place on the areas which had been in 20-inch rows cut short, 40-inch rows cut 12 inches high, and 40-inch rows cut 4 inches high. The accompanying photographs illustrate the effectiveness of the narrow row width and higher stubble in reducing erosion on these sandy soils.

Texas

RAINFALL SIMULATOR AND FIELD PLOT DATA SHOW GENERAL AGREEMENT

J. E. Adams, R. M. Smith, and R. C. Henderson, Temple. --General agreement between rainfall simulator and field plot data indicates that the rainfall simulator may have promise in evaluating the relative influence of cropping systems and management on water intake and soil erodibility.

Field measurements of infiltration and erosion were made with a portable rainfall simulator infiltrometer on 3 cropping systems at Temple, Tex. The cropping systems are on 12 field scale (1-1/2 acres) instrumented runoff-erosion plots which are on predominately Houston Black clay. The 3 cropping systems are: (1) Continuous row crop (cont. corn), (2) one year of corn, one year of oats with sweetclover (corn-oats) and

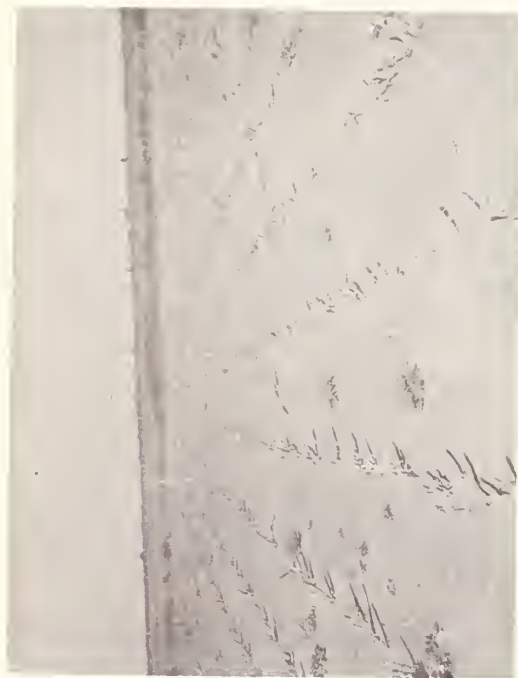


Figure 1. --40-inch row width sorghum stubble cut at 4-inch height.
Note soil removal between rows.

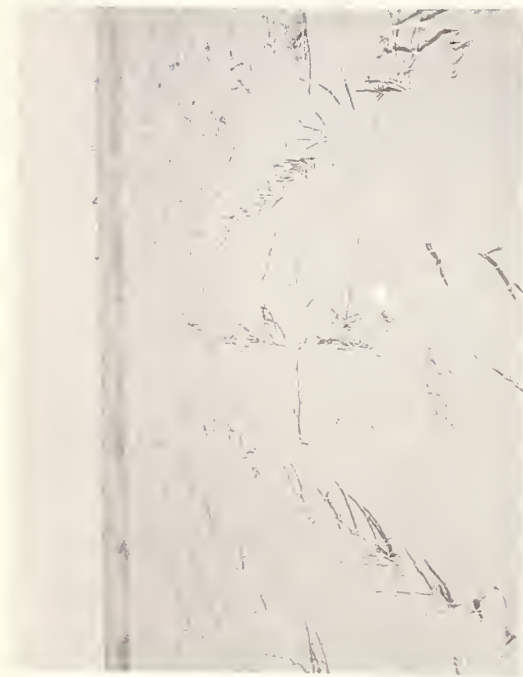


Figure 2. --40-inch row sorghum stubble cut 12 inches high. Note
depositions of coarse sand near stubble.

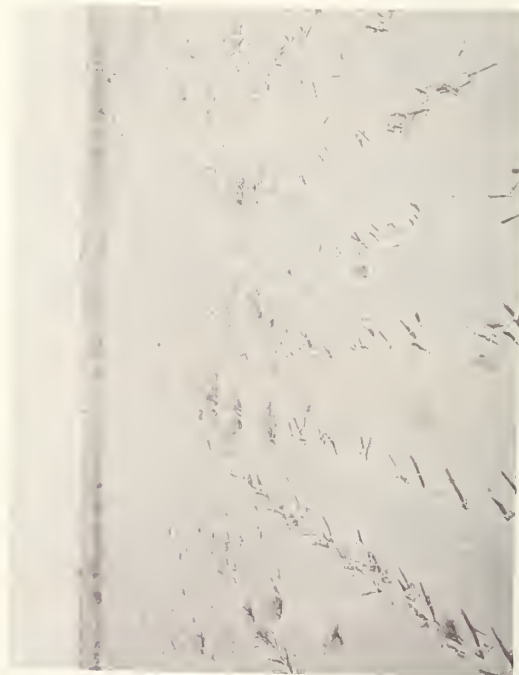


Figure 3. --20-inch row sorghum stubble cut 4 inches high. There is
only slight soil removal and deposition here.

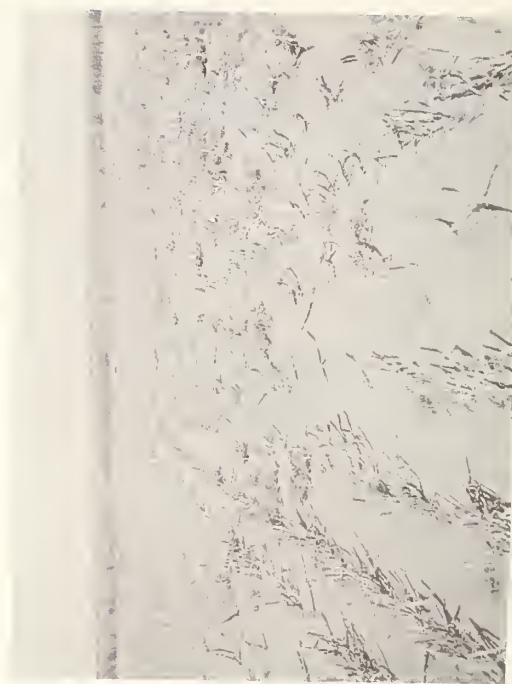


Figure 4. --20-inch row sorghum stubble cut 12 inches high. Practi-
cally no soil removal or accumulation.

(3) one year of corn, two years of fescuegrass with sweetclover (corn-fes. -fes.). All tillage was done by stubble-mulch methods.

Infiltration and erosion measurements were made at 6 sites in the corn phase of each cropping system. The infiltration cylinders were installed in the corn rows and leveled to zero slope. An excess of water was added to the soil in and surrounding each infiltration cylinder and the soil allowed to drain to a tension of 0.15 atmosphere before measurements were made. A total of 2 inches of rainfall was applied at the rate of 4.2 ± 0.2 inches per hour for each measurement.

The infiltration, runoff, and soil loss data for the rainfall simulator and from the plot instrumentation are shown in the table.

Both rainfall simulator and field-scale plot data showed significant differences in soil loss between the continuous corn and corn-fes. -fes. cropping systems. A ratio comparison of continuous row crop to corn-fes. -fes. for the total soil and water losses from the field-scale plots (1953-1957) was 1.51 for runoff, 3.61 for total soil loss, and 2.38 for soil loss per inch runoff as compared to 1.73, 3.84, and 2.27, respectively, with the rainfall simulator. Disagreement between rainfall simulator and field-plot data from corn-oats relative to continuous corn was probably caused by the surface residue effect on the field plots. All residue was removed from the soil surface within the infiltration cylinders at the time of installation.

The general agreement noted between rainfall simulator and field plot data should be investigated further. Water intake and soil erodibility data can be obtained in the field in a much shorter time and more economically with artificial rainfall than by the use of runoff control plots. The rainfall simulator can be used to compare the relative erodibility of soils with a given cropping system, as well as to evaluate the effect of cropping system and management on a given soil.

Comparison of rainfall simulator and field-scale plot soil and water loss from the corn phase of three cropping systems on Houston Black clay at Temple, Tex.

Cropping system	Rainfall simulator infiltrationmeter data				Field-scale runoff plots annual average, 1953-57		
	Water		Soil loss		Water	Soil loss	
	Infiltration	Runoff	Per acre	Per inch of runoff	Runoff	Per acre	Per inch runoff
	<i>Inches</i>	<i>Inches</i>	<i>Tons</i>	<i>Tons/acres</i>	<i>Inches</i>	<i>Tons</i>	<i>Tons/acres</i>
Continuous <u>corn</u>	0.56	1.44	0.73	0.51	2.71	7.33	2.70
<u>Corn</u> -oats.....	0.67	1.33	0.88	0.66	1.98	3.41	1.72
<u>Corn</u> -fes.-fes.....	1.17	0.83	0.19	0.23	1.79	2.03	1.13

SOIL FERTILITY

Texas

ORGANIC MATTER DECLINES WITH STANDARD CROPPING SYSTEMS

R. M. Smith and J. E. Adams, Temple. --Detailed soil organic matter and nitrogen determinations indicate downward trends over the past 5 years with corn following oats-sweetclover, as well as with continuous corn. Where corn was grown following 2 years of fescuegrass-sweetclover, the organic matter content is essentially balanced at the present level of about 2.5 percent, and with continuous small grain-sweetclover for

grazing, there has been an increase. These observations were made on field-scale run-off-erosion plots on Houston Black clay.

The accompanying table summarizes results from these plots where average slope is 2.37 percent, and also from 4 adjacent fields with slopes from 1 to 4 percent which have been used for grazing of continuous small grain with sweetclover. In the case of the grazing fields, there has been an average soil organic matter increase of about 0.04 percent per year. This corresponds to a total nitrogen increase in the plow layer of about 40 pounds per acre per year. In addition, the subsurface layer, from the 7 to 12 inch depth, showed an annual organic matter increase of about 0.03 percent, or approximately 25 pounds per acre. The total apparent increase of 65 pounds of N per year is approximately equal to the decline shown by the plow layers of the continuous corn. Erosion with continuous row crops is high enough to account for an annual loss of about 15 pounds of N per acre.

In considering these results, it should be remembered that soil organic matter and nitrogen changes over periods of 5 to 6 years are relatively small in all cases. Also, soil variability is such that significant sampling errors are unavoidable, even when the number of replicate samples is relatively large, as in the present case. For example, the 6 surface soil samples taken from plot 0-1 in 1957 showed a range of organic matter from 2.45 to 2.88 percent, and with plot P-6, the range was from 1.98 to 2.47 percent. These are typical of the ranges within the other 10 field plots.

Previous data from this location showed somewhat slower organic matter declines than in the table, and it is believed that the 2-year, corn-oats with sweetclover system normally provides a more favorable organic matter balance than is indicated by the present results. Additional years of record are needed in order to be sure.

Two years of grass with sweetclover preceding each year of corn appears to have established some stability. Samples in 1954 and 1955 showed slightly more organic matter than the original samples collected in 1952, whereas the 1957 samples average very slightly less. Averages on the 4 sampling dates are not significantly different.

Soil organic matter in relation to cropping system in field scale plots on sloping Blackland

Cropping system	Soil organic matter - 0 to 7 inch depth					
	Date sampled				Change	
	1952	1954- 1955 av.	1957	1958	Total	Per year
Continuous corn (2 fields)....	Percent 2.77	Percent 2.61	Percent 2.46	Percent --	Percent -0.31	Percent -0.06
Corn, Oats with sweetclover (4 fields).....	2.71	2.55	2.41	--	-0.30	-0.06
Corn, fescuegrass with sweet- clover 2 years (3 year sys- tem) (6 fields).....	2.52	2.58	2.50	--	-0.02	0.00
Continuous small grain with sweetclover for grazing (4 fields).....	2.56	--	--	2.80	+0.24	+0.04

SWEETCLOVER FURNISHES AMPLE NITROGEN FOR FOLLOWING CORN CROP

Jesse W. Collier, Temple.--The ability of sweetclover to furnish sufficient nitrogen for high corn yields in a corn-sweetclover cropping system has been shown clearly over a 6-year period. Even with irrigation, no responses were obtained to nitrogen application on corn following sweetclover. Nitrate determinations on soil samples show high amounts of nitrogen after sweetclover, and total nitrogen determinations in corn leaves also showed sufficient nitrogen for high yields.

A corn production study has been conducted on Houston Black clay near Temple, Tex., over the past 6 years. Cropping systems include continuous corn and corn after sweetclover. Treatments of nitrogen fertilization and irrigation were made in each cropping system. Irrigation was usually made during June and early July, and the amounts of water applied varied from 4.5 inches in 1957 to 12 inches in 1954. Nitrogen fertilization included an application of 90 pounds of N per acre before planting corn. Nitrate analyses were made on soil samples taken during the growing seasons of 1952, 1953, and 1954. Leaf nitrogen in the second leaf below the ear was determined at 3 stages of development in 1954 and at full tassel in 1955.

Corn yields from either nonirrigated or irrigated plots following sweetclover were not increased by additional nitrogen. This lack of response to nitrogen following sweetclover was very consistent for each year of the study. Without irrigation, the 6-year averages were 54 bushels per acre without additional nitrogen and 51 bushels per acre with extra nitrogen following sweetclover. With irrigation, the yields were about 35 bushels per acre higher than those from nonirrigated plots, but no response occurred from additional nitrogen following sweetclover. Six-year averages were 90 bushels per acre without nitrogen fertilization and 87 bushels per acre with additional nitrogen. The combination of 90 pounds of nitrogen per acre and irrigation in the continuous corn system did not give yields equal to those from irrigated plots following sweetclover. The 6-year average from the fertilized and irrigated continuous corn plots was 76 bushels per acre as compared with a 90 bushel per acre average from irrigated corn following sweetclover.

Soil nitrate analyses during the growing seasons of 1952, 1953, and 1954 showed a generally higher nitrate nitrogen content in plots following sweetclover than from continuous corn. The greatest difference usually occurred during May and early June, when nitrate levels in all plots reached their peaks. However, after the corn made its maximum demand for nitrogen, slightly higher amounts of nitrate nitrogen were found at most dates in plots following sweetclover than in continuous corn plots with similar treatment.

The leaf analyses for nitrogen made during 1954 and 1955 are shown in the accompanying table. Data of other workers show that responses to added nitrogen were not usually obtained, if the leaf nitrogen at full tassel was 2.8 percent or higher. If this is the critical level, only the leaf samples from the continuous corn plots that received no nitrogen were consistently deficient in nitrogen. Yields in 1955 from irrigated plots following sweetclover were slightly over 100 bushels per acre and, yet, leaf nitrogen at maturity was rather high as indicated in the table.

Yields, soil nitrate analyses, and total leaf nitrogen percentages of corn leaf samples present a consistent picture of the nitrogen potentials from the corn-sweetclover cropping system.

Nitrogen in the corn leaf at different stages of maturity during 1954 and 1955

Cropping system	Nitrogen fertilization	Irrigation	Nitrogen in second leaf below ear at various stages of corn growth			
			1954			1955
			Before tassel	Full tassel	After tassel	Full Tassel
	<i>Pounds of N</i>		<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
Continuous corn.....	0	0	3.21	2.02	1.69	2.18
	0	Irrigated	3.20	2.00	1.88	1.88
	90	0	3.74	2.89	2.41	2.63
	90	Irrigated	3.72	3.18	2.74	2.68
Corn after sweet-clover.	0	0	3.39	2.74	2.30	2.91
	0	Irrigated	3.69	3.10	2.56	3.02
	90	0	3.81	3.13	2.58	3.73
	90	Irrigated	3.84	3.37	2.84	2.91

Washington

SULFUR DEFICIENCY MAY CAUSE POOR GROWTH OF ALFALFA

Louis C. Boawn, Prosser. --Sulfur deficiency of alfalfa has been observed on several occasions on farms in the Yakima Valley, and, where growth of alfalfa is poor, farmers should consider the need for sulfur fertilization. It is most likely to occur on slopes adjacent to gullies, where considerable surface soil has been removed by erosion, or where blow sand has accumulated.

Sulfur deficient alfalfa shows a general stunting. Stem growth is short and spindly, and there is a general loss of green color. Because stooling is less than normal, the stand may appear poor.

A suspected deficiency can be diagnosed by simply making a trial application of a soluble sulfur compound such as gypsum. Apply the fertilizer material in such a manner that it will be leached into the soil by the irrigation water. Broadcasting will be satisfactory, if sprinklers are used, or banding along the bottom of the irrigation furrow, if irrigation is by furrow. If sulfur deficiency exists, improved growth should be noted within a few weeks after the material has been dissolved into the soil.

Sulfur deficiency can be corrected by applying about 60 pounds of soluble sulfur per acre. Agricultural gypsum is a readily available source of soluble sulfur, or if phosphate is being applied, the sulfur may be obtained by applying single superphosphate which contains approximately 50 percent gypsum.

MOISTURE CONSERVATION

Kansas

CHEMICAL REDUCES EVAPORATION AND INFILTRATION

S. A. Bowers and R. J. Hanks, Manhattan. --Soil moisture evaporation was substantially reduced under laboratory conditions by the treatment of soils with Arquad 2HT (dihydrogenated tallow dimethyl ammonium chloride). Over a 14-day period, moisture loss from Ladysmith silty clay loam was reduced 63 percent by a 0.07 percent application to the surface 2 inches (figure 1). A decrease of 67 percent resulted from a 0.06 percent treatment of Wabash silty clay loam. Savings of like magnitude were achieved in treating Ashland fine sandy loam with a 0.14 percent Arquad 2HT. A suitable method of field application has not yet been worked out.

In a similar manner, Arquad 2HT decreased the infiltration rate (figure 2). On Wabash silty clay loam treatments of 0.05, 0.10, and 0.50 percent reduced infiltration 73.6, 84.2, 95.6 percent, respectively. A decrease of 95.8 percent resulted from treating Ashland fine sandy loam with 0.50 percent Arquad 2HT; smaller application had no apparent effect.

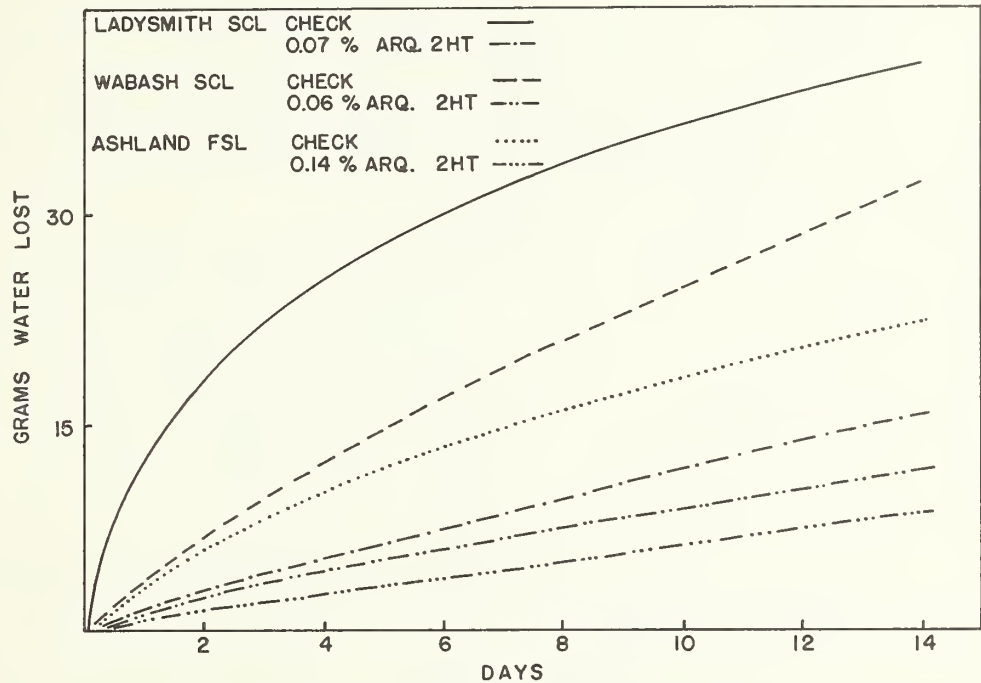


FIGURE 1. -- EFFECT OF ARQUAD 2HT ON SOIL MOISTURE EVAPORATION

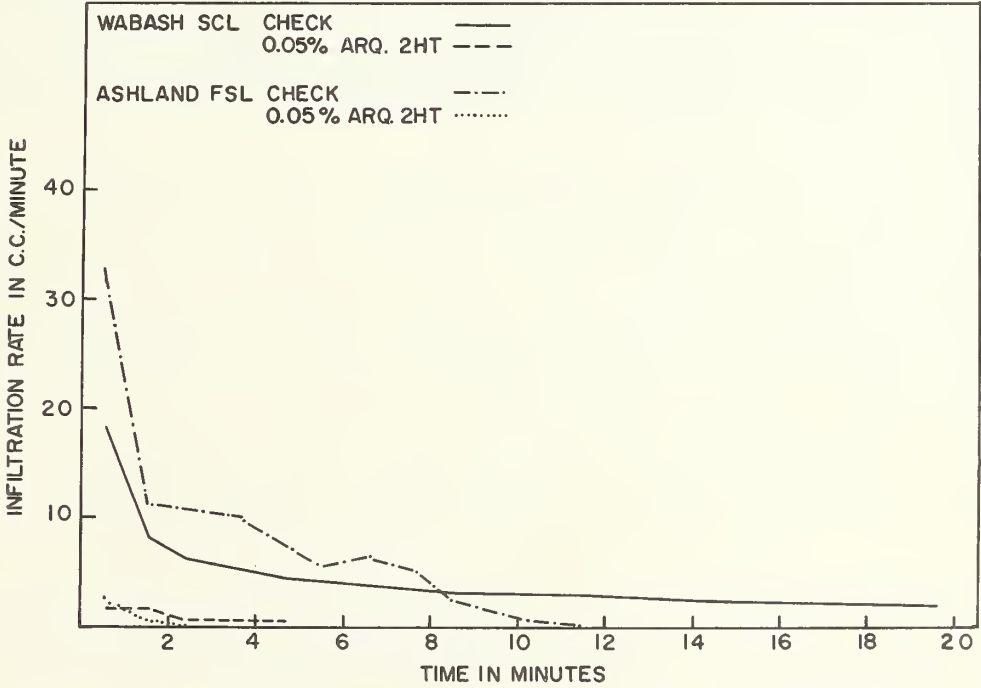


FIGURE 2.-- EFFECT OF ARQUAD 2HT ON INFILTRATION IN SOILS

The reduction of infiltration complicates the use of Arquad 2HT in evaporation control. However, these reductions in infiltration suggest the possible use of Arquad 2HT as a pond and canal sealer.

TILLAGE AND CULTURAL PRACTICES

Texas

MOISTURE CHANGES CONTROL ROOT EXPANSION IN PLOWPAN

H. M. Taylor, A. C. Mathers, and F. Lotspeich, Bushland. --Changes in moisture content of a plowpan controlled the ability of cotton roots to expand in the compacted layer of a Carey fine sandy loam soil near Roby, Tex.

A series of field observations was made during the growing season, where a plowpan had been created during planting. Farmers in the area planted cotton while the soil was wet, and the shoe of the planter created a U-shaped zone around the seed as shown in accompanying figure. Since the compacted zone was moist when the cottonseed germinated, the tap root penetrated the plowpan but no rain occurred for approximately 45 days. As a result, the plowpan dried and "set" into a hard layer. The tap root expanded very little in the plowpan, even though the stalk development seemed normal until the plants showed moisture stress. Near the end of the 45-day drought period, cotton roots had not expanded in the plowpan, and some plants had died. Two weeks after a 1-1/2-inch rain, the roots were expanding normally in the plowpan zone, even though the bulk density of the plowpan (1.75 gms/cc) had not changed.

When the hard dry plowpan was wet by the rain, the plowpan became plastic enough for the cotton root to develop. In this soil, roots could expand in the moist compacted soil but could not expand in the dry soil.

In a nearby field across a property line, the farmer waited an extra 36 hours to plant, and this type of plowpan did not develop. The moisture content at the time of planting controlled plowpan formation with only small changes in moisture necessary to prevent plowpan formation on this soil.

Texas

TERRACES INFLUENCE SOIL MOISTURE AND WHEAT YIELDS

Victor L. Hauser and Ronald R. Allen, Bushland. --Level terrace systems are designed to retard runoff water and provide an opportunity for storing more of any runoff producing rain in the soil. Soil moisture measurements made in July 1957 and wheat yield measurements made in 1958 show that such systems do store extra water, and that it can be used for crop production.

Soil moisture samples were taken in a fallow field with a level closed end terrace system to determine the moisture distribution in the soil. Two cross sections were sampled in July 1957, and the average values for soil surface elevation and available soil moisture are shown in the accompanying figure.

Yield samples of hard red winter wheat harvested in June 1958 were obtained by weighing the grain cut from a strip 10 feet wide the entire length of the field. The strips were harvested parallel to the terrace ridges. Yield results are also shown in the figure.

Wheat yield in the channel was 34.5 bushels per acre, where about 9.1 inches of available water was stored. This is less than was produced immediately above the channel on 6.8 inches of available water. It seems likely that the reduced yield in the channel was caused by the removal of about 0.5 foot of top soil. No water was ponded in the channel from seeding time to harvest.

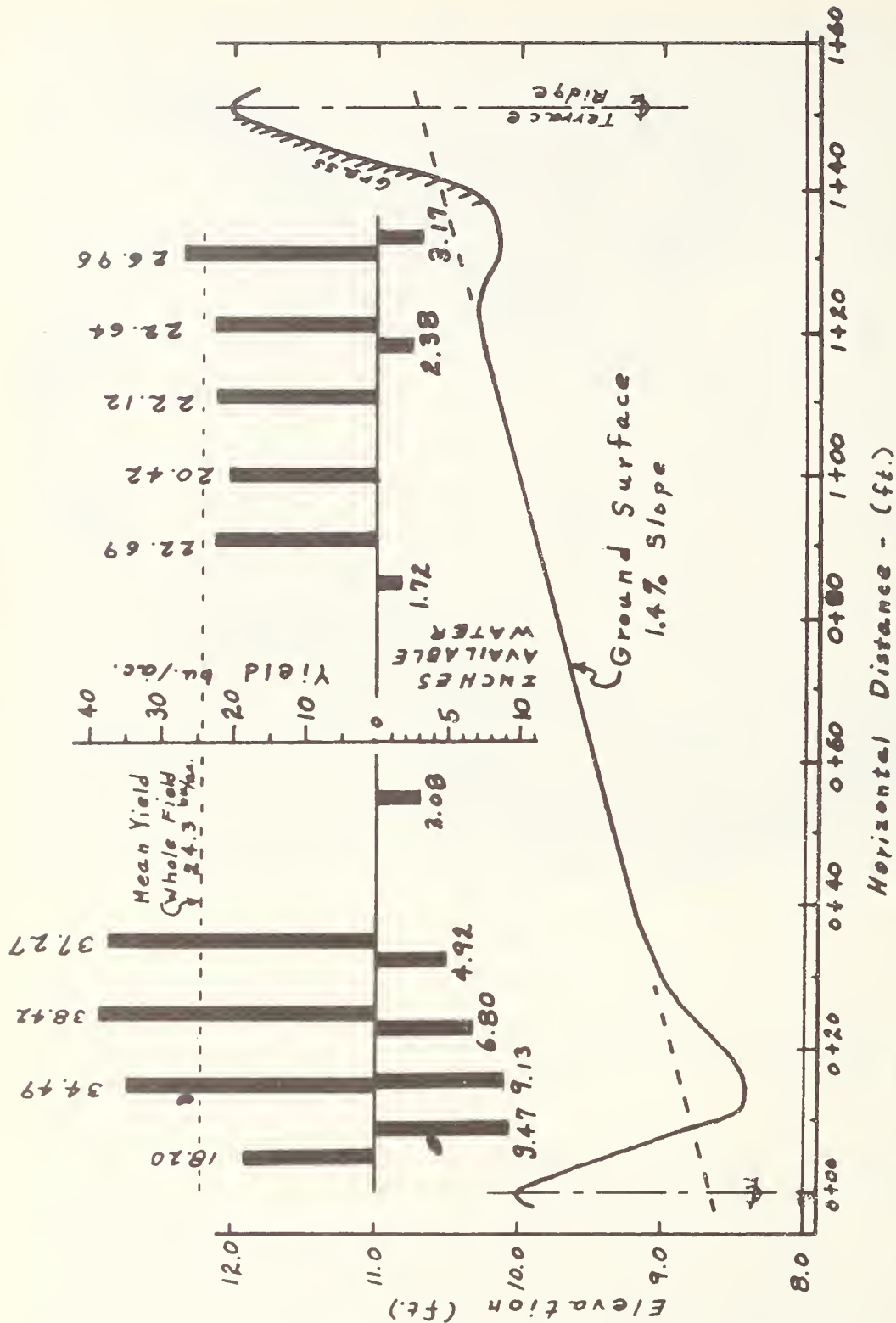


Farmers in the area planted cotton while the soil was wet, and the shoe of the planter created a U-shaped compacted zone around the seed.

Wheat yields on a whole field basis for graded and level terraces and a short non-terraced slope are as follows for the 1958 harvest: Level 24.6 bushels per acre; graded, 21.7 bushels per acre; and nonterraced, 19.6 bushels per acre. Ten-year average wheat yields on level and graded terraced fields are: Level, 9.53 bushels per acre; graded 9.59 bushels per acre.

During wet years, the graded terraces tend to produce the most grain, and during dry years, the level terraces tend to produce more grain. The 10-year average seems to indicate little advantage for either system over the other.

The uneven moisture storage in the channel area and the concentration of runoff water seems to indicate that, for conditions as shown in the figure, some means of spreading the accumulated runoff water is needed. Conservation benches have given some promise for conserving runoff water more efficiently for grain sorghum production and may offer a solution to the problem for wheat.



Relationship between ground surface elevation, soil moisture storage and wheat yields on level-terraced land, Bushland, Texas. Values for inches of available water and ground surface elevations are the mean values for two locations. Wheat yields were obtained by cutting a swath 10 feet wide the entire length of the field.

Montana

PROBLEMS OF CHEMICAL FALLOW REVEALED

J. F. Power, Sidney. --Use of chemical weedicides as a partial substitute or complete replacement for mechanical fallow operations appears possible from present research results. However, much more research information is required before such a fallow system will become practical in commercial operations.

Investigations on chemical fallow were initiated at the Eastern Montana Branch Station in 1956. The work was conducted on the Williams soil series (glaciated silt loam and sandy loam), a Chestnut soil in the 13-inch precipitation zone. Spring wheat was used as the test crop. Results of these investigations revealed many problems that include selection of a weedicide that will provide adequate weed control; proper method and time of application of the weedicide; increased moisture loss under chemical fallow; seeding difficulties; and weed control in the crop.

The adaptability of various experimental and commercial weedicides for chemical fallow was studied for three seasons. None of the weedicides investigated provided dependable weed control on the fallow when applied in late spring after the fallow became green with weed growth. Principal weeds were wild oats, Russian-thistle, and wild buckwheat in the spring and green foxtail in July and August.

When applied pre-emergence or when the weeds still in the seedling stage, several chemicals offered a great deal of promise. Most outstanding to date were the trichlorobenzoic acid materials. A 2- or 3-pound per acre application provided adequate weed control during the entire summer without leaving a residue in the soil sufficient to injure the succeeding spring wheat crop. Applied post-emergence in late spring, they have given fairly good control of most weeds, except wild oats. Other weedicides that provided adequate weed control when applied pre-emergence include Alanap, Eptam, Dowpon, and 3 y/9. However, most of these materials required a second spray application by midsummer. The product Simizan provided excellent grassy weed control all season, but under dryland conditions, its residual effect was so great that the following spring wheat crop failed to emerge.

The moisture content of chemically fallowed soils at the close of the 1957 fallow season was significantly lower than that of soil fallowed by conventional mechanical methods, even though weed control on these chemical fallow plots was good. This was probably because of the higher evaporation losses from the chemical fallow, since the density of the surface 9 inches of this soil was definitely higher than that of the mechanically fallowed soils.

Seeding in chemical fallow offered some difficulties because of the large amounts of residues present. Hoe-type drills have operated satisfactorily in chemical fallow whereas disk-type drills did not penetrate the soil deep enough, and trouble with clogging was encountered.

Weed growth in the spring wheat crop seeded on chemical fallow was definitely more serious than on mechanical fallow. This probably resulted from the germination of weed seeds that remained on the soil surface of chemical fallow, that were worked into the soil during seeding operations.

Work on chemical fallow at this station is continuing and is being expanded to determine methods of overcoming these problems.

SOIL AND WATER MANAGEMENT--GENERAL

Arizona

SANDY SOIL IS WARMER THAN LOAM WINTER AND SUMMER

Joseph Hamilton and Mark Lowrey, Yuma. --Superstition loamy sand from the Yuma Mesa is warmer summer and winter at the 6-inch level than Glendale silty clay loam from the Yuma Valley.

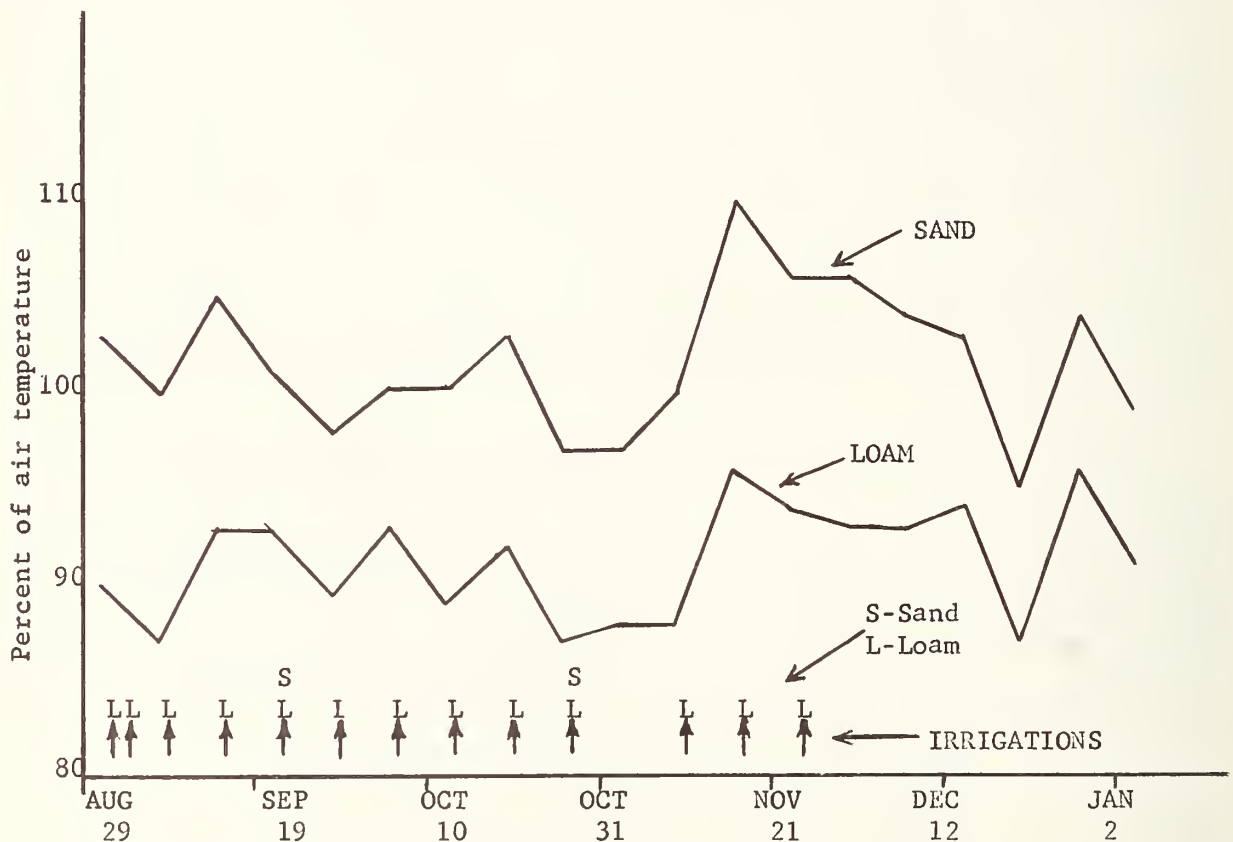
Diurnal temperature fluctuations at the 6-inch depth is significant for the sand but negligible for the loam. Mulching the surface of this loam soil reduced the loss of water

from the soil surface by evaporation, especially at soil moisture tensions greater than 100 cm. of water at the 6-inch depth. The loam soil required as many as 5 irrigations for each irrigation of the sand to maintain soil moisture tensions at less than 200 cm. of water.

The air temperatures, soil temperatures, and soil moisture tensions were recorded for the same 2 plots for 2 years. However, the loam was held at a tension of 250 to 400 cm. the second year instead of under 200 cm. As a result, the loam was an average of 8° F. warmer under higher tension and was only 2.7° cooler than the sand. During December of the second year both the sand and the silt were at the same tensions, approximately 250 and 325 cm. During this period, the sand was only 2.9° warmer than the loam compared with 6.4° previously.

These results were obtained from a study of representative top soils of the 2 series contained in 2 adjoining excavations (each 12 feet x 22 feet x 3 feet) adjacent to the laboratory buildings on the Yuma Mesa.

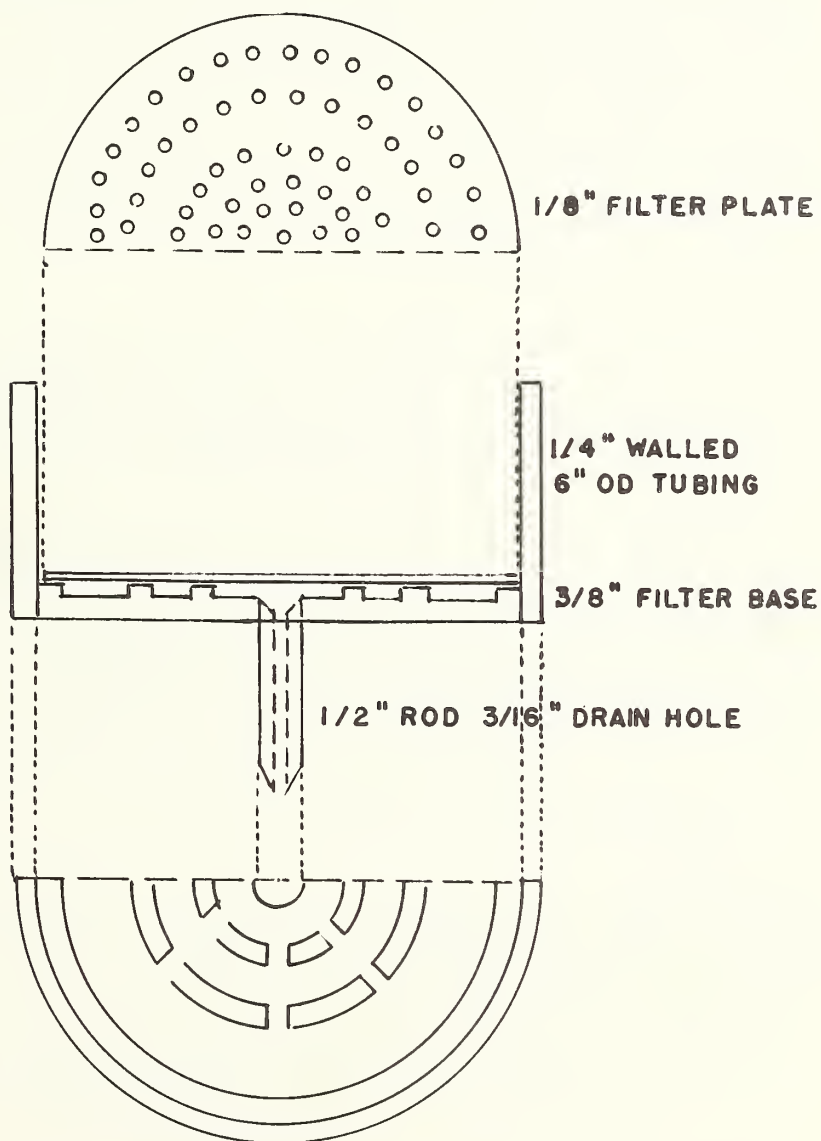
A summary of soil temperatures for the period of study is presented in the accompanying figure.



Soil temperatures, expressed as percent of corresponding weekly mean air temperature. Mean of readings at 8:00 a.m. (min.) and 4:00 p.m. (max.) at 6-inch depth.

MODIFIED FILTER FUNNEL FOR SOIL SOLUTION EXTRACTION

V. S. Aronovici, Pomona. --If you are having trouble in obtaining sufficient leachate from a fine-textured soil, try using this modified funnel design. This filter funnel, illustrated below, is a modification of the unit originally developed by Dr. L. A. Richards of the U. S. Salinity Laboratory. The advantage of this modification are that it provides for the same drainage surface available in a conventional Buchner funnel, but without the accompanying difficulty of cleaning and drying. Considerably more solution can be extracted from fine-textured soils in a fraction of the time required when using the older model. Difficulty in cleaning and drying is eliminated by blowing on the bottom of the funnel to remove the plate and cake. Constructed of lucite and easily machined with a conventional lathe, the funnel is considerably cheaper and more durable than the ceramic funnel.



Quick Cleaning Soil Solution Extraction Filter Funnel

HYDROLOGY-GENERAL

Virginia

LOW RUNOFF FROM WATERSHEDS WITH FROZEN SOILS

J. B. Burford and J. H. Lillard, Blacksburg. --In spite of the frozen soils, approximately 80 percent of one-half-inch rainfall was retained on a Pulaski County watershed. Air and soil temperatures established that the ground was frozen to a depth of at least 0.25 of a foot before and during the storm. The watershed is in the area of limestone and shale derived soils of the Ridges and Valleys Region.

Other data, from Blacksburg, Va., show that these soils of the Ridges and Valleys Region generally produce low direct runoff, even during the months when frozen ground often occurs. For example, 18 years of record from a 19.2 acre cultivated watershed with soils quite similar to those of the Thorn Creek watershed, show that with an average of about 7.8 inches of rainfall during the winter season of December, January, and February, only a trace of runoff on the average has occurred during this season.

It has been reported in other areas, under frozen ground conditions, that all of the rainfall has been lost as runoff. For example, at the Coshocton, Ohio, experimental watershed, all of the rainfall from two storms of 0.26 and 0.13 inches in the same day was lost from a meadow watershed.

Texas

INITIAL ABSTRACTION ESTIMATED FROM SOIL MOISTURE INDEX

M. A. Hartman, Riesel. --Studies carried out at the Blacklands experimental watershed show that the amount of moisture that can be absorbed before runoff begins from a Houston Black clay soil watershed in native grass meadow can be determined from a knowledge of the antecedent soil moisture.

Data from a 3-acre watershed equipped with a water stage recorder was used for the studies. Rainfall data was in terms of daily rainfall amounts. An antecedent soil moisture index (ASM) was expressed in terms of the inches of moisture above 18 percent (approximate wilting point) in the upper 3 feet of soil at the beginning of the rain. The soil moisture prior to a given rainstorm was estimated by starting with the soil moisture content indicated on the most recent sampling date, adding rainfall, and subtracting runoff and the estimated losses of soil moisture by evapotranspiration and deep percolation since the sampling date. The estimate of evapotranspiration and deep percolation loss assumed uniform depletion between sampling dates.

The relationship between the antecedent soil moisture index and the retained rainfall is shown in the figure below. The 12 storms plotted in this figure produced only traces of runoff.

The correlation coefficient with 12 items ($r = 0.993$) is significant at the 1 percent level. The line of best fit computed by least squares is:

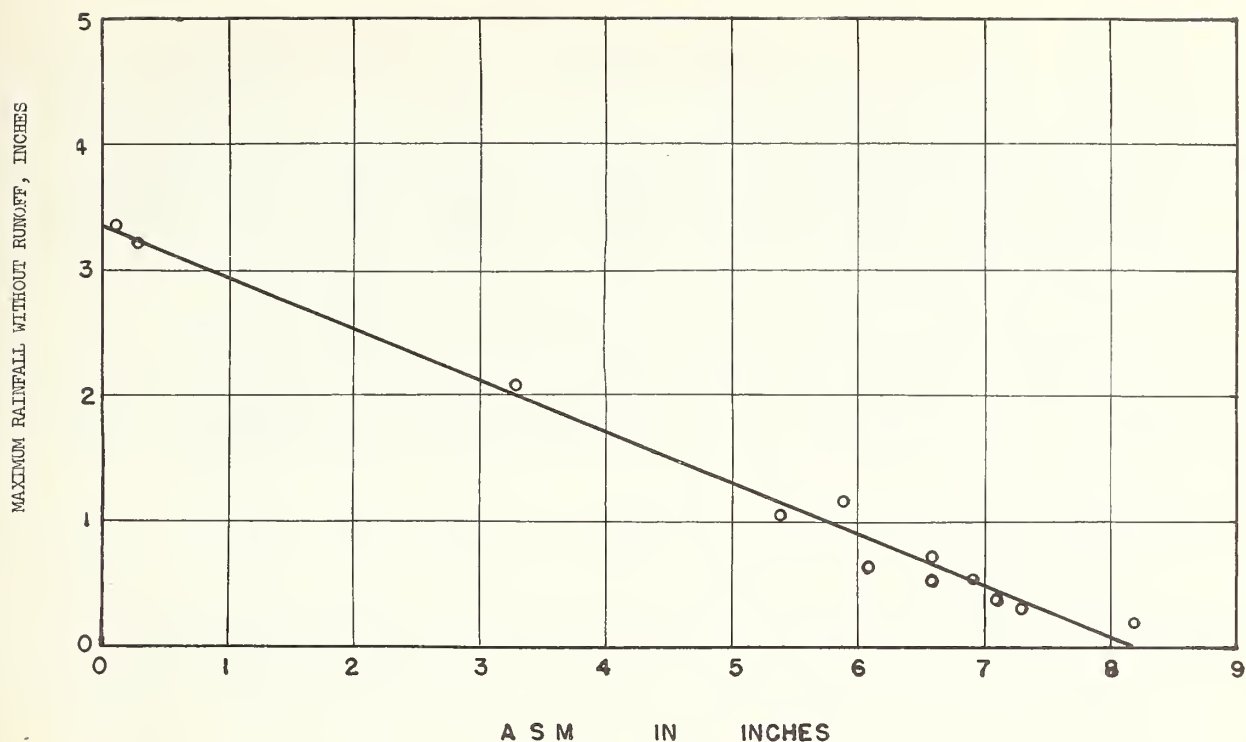
$$P_1 = 3.37 - 0.41 \text{ ASM}$$

when:

$$P_1 = \text{Daily precipitation, when runoff begins (inches)}$$

$$\text{ASM} = \text{Antecedent soil moisture index (inches)}$$

A review of daily rainfall, runoff, and soil moisture data at Riesel indicated that all the storms which produced no runoff plotted below the computed line of the figure. Storms with more than 0.01 inches runoff plotted above the computed line.



Relationships between the maximum amount of rainfall absorbed without appreciable runoff and the antecedent soil moisture (ASM) index

Michigan

ENGINEER ASSIGNED TO PROJECT

R. L. Roberts, East Lansing. --Mr. Roy L. Roberts, hydraulic engineer, formerly of College Park, Md., was transferred to this station to serve as a research investigator and project leader. His work here will deal primarily with the analysis of data relating to the effects of snow and frozen soils on the hydrology and sediment yield of small watersheds at this location.

HYDROLOGY-LAND USE INFLUENCES

West Virginia

HYDROLOGIC STUDY INITIATED

Vernon Shanholtz, Moorefield. --Hydrologic equipment on four pasture watersheds of about 10 acres each was put into operation before the first of June. The shale soil of these watersheds is typical of the shale so extensive throughout the Ridge and Valley Problem Area of West Virginia, Pennsylvania, Virginia, Kentucky, and Tennessee. After an initial period of observations of 3 to 5 years, 2 of these watersheds are scheduled for deep chiseling. Records obtained from this study will provide some basic data for evaluating the effects of this treatment on flood runoff and water yield from small upstream watersheds.

Ohio

PLOW-PLANTING OF CORN REDUCES WATERSHED RUNOFF AND EROSION

L. L. Harrold, Coshocton. --Studies on small watersheds planted in corn showed that the plow-plant practice resulted in less runoff and soil loss than did straight row culture or an improved practice consisting of contouring and adequate fertilizing. The following table presents data for the 3 years of these tests. Erosion in every case was least on this practice. Runoff, with the exception of seepage flow, was also reduced by this minimum-tillage practice.

Runoff, erosion, and crop yield on watersheds planted to corn. May-September 1956, 1957, 1958

Year	Watershed treatment	Runoff per acre	Erosion per acre	Yield per acre	Stand per acre
1956	(Well drained soil)	<i>Inches</i>	<i>Tons</i>	<i>Bushels</i>	<i>Number</i>
	Straight row.....	3.65	7.09	70	10,000
	Improved.....	1.67	1.10	105	11,800
	Plow-plant.....	.21	.03	82	11,900
1957	(Slowly permeable soil)				
	Straight row.....	2.24	7.06	55	11,400
	Improved.....	3.08	6.69	109	13,200
	Plow-plant.....	3.51**	2.16	124	22,800*
1958	(Slowly permeable soil)				
	Straight row.....	0.93	0.42	45	10,500
	Improved (contour).....	.97	.21	118	14,000
	Plow-plant (contour).....	.17	Trace	101	11,900

*Planting rate increased only in 1957.

**Considerable seep flow in this total.

HYDRAULICS

Oklahoma

ROW DIRECTION HAS LITTLE EFFECT ON SPILLWAY EROSION

W. O. Ree, Stillwater. --A field trial, comparing Bermuda grass planted in rows crosswise the spillway with rows lengthwise, did not indicate any apparent difference in the amount of erosion in the spillway during the establishment period.

Two spillways on detention reservoirs of the Long Branch Creek Watershed were selected for this study by Mr. Maurice Gamble of the Soil Conservation Service. The basic features of these spillways are given in the following table:

	Site No. 8	Site No. 11
Bed slope	8 percent	5.46 percent
Bed width	72 feet	75 feet
Spillway length	200 feet	308 feet
Texture	clay loam	clay loam
Grass	Bermuda	Bermuda

Bermuda grass roots were machine planted in the spillways during the latter part of April. The rows were 2 feet apart. Both row directions were included in each spillway. During the growing period 24.97 inches of rain fell at Site No. 8 and 22.72 inches at Site No. 11. The reservoir did not discharge over the spillway and the only runoff over the plantings was from rain falling directly into the spillway. Rainfall intensities were generally low and only one good test occurred. At that time the plantings were 2 months old and the cover was about 40 percent complete. Some rill erosion took place during the storm. However, the results were obscured by variations in cover density and by the location variable (distance from crest). Row direction made no real difference.

The spillways were inspected the latter part of September. Both were found to be nearly covered with a dense growth of Bermuda grass. Old rills were either hidden or healed over. No real difference in cover density or the amount of scour damage could be noticed between the cross-wise and the lengthwise row areas. In fact, the original row direction could no longer be detected. Consideration should be given to the very favorable rainfall experience in evaluating this result.

Minnesota

CRITERIA, HOOD DROP INLET FOR CLOSED CONDUIT SPILLWAY

C. A. Donnelly, Minneapolis. --The hood drop inlet is formed by locating a hood barrel inlet at the base of a drop inlet. This permits the use of low drop inlet heights and yet insures priming of the spillway. However, certain minimum criteria must be used to insure desirable flow conditions.

Criteria for the design of the hood drop inlet are based on tests made with square drop inlets 1D, 1.11D, 1.25D, 1.5D, 2D, 4D, and 6D square, and circular drop inlets 1.32D, 1.55D, 1.98D, 3.77D and 5.11D in diameter where D is the barrel diameter. The heights of the drop inlets above the invert of the hood entrance, which have been tested, are 4D, 2D, 1.5D, 1.25D, 1D, 3D/4, and D/2. The hood length is 3D/4. The only barrel slope used to date is 20 percent. The barrel wall was "thick" for all tests and the entrance loss coefficients are minimum values which, on the basis of previous data, must be increased if the barrel is thin-walled.

The 1D square drop inlet is so small that the hood chokes the flow and the performance is unsatisfactory. Satisfactory performance is defined as the ability to cause the conduit to flow full as soon as the rate of flow is sufficient. The other drop inlet sizes give satisfactory performance when the drop inlet is 4D high. The minimum drop inlet size for satisfactory performance increases as the drop inlet height decreases. This is shown by the observation that for drop inlet heights of 2D, 1.5D and 1.25D, the boxes must be 1.5D square or larger to perform satisfactorily.

The entrance loss coefficient K_e is very high for the small drop inlet. It decreases with increase in drop inlet size until, for the largest drop inlets tested to date, the coefficient is less than that previously obtained without a drop inlet. The entrance loss coefficients increase as the drop inlet heights decrease and reach a maximum at drop inlet heights of 1D to 1.25D. Further decrease in box inlet height results in a lowering of the entrance loss coefficient.

The minimum drop inlet heights given in the following table are the minimum height of drop inlet at which the barrel will prime reliably. Heights less than this should not be used. Greater heights may be used. The values of K_e presented apply only to the minimum riser height and are different for other drop inlet heights for most sizes of drop inlet.

Minimum height of drop inlet for reliable priming of barrel

Drop Inlet		K _e Thick-wall pipe
Size	Minimum height	
1.00 D square.....	Unsatisfactory	--
1.11 D square.....	4.00 D	1.6
1.25 D square.....	4.00 D	1.1
1.50 D square.....	1.25 D	1.0
2.00 D square.....	1.25 D	0.7
4.00 D square.....	D/4	0.6
6.00 D square.....	D/4	0.6
1.32 D round.....	4.00 D	1.2
1.55 D round.....	1.50 D	1.2
1.98 D round.....	1.25 D	0.8
3.77 D round.....	D/2	0.6
5.11 D round.....	D/2	0.6

LIST OF RECENT PUBLISHED PAPERS AND PUBLICATIONS

Some of the recent published papers and publications written solely or jointly by staff members of the Soil and Water Conservation Research Division are listed below.

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